Kesterson Reservoir Ecological Risk Assessment

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RESEARCH OBJECTIVES

Kesterson Reservoir, California, which was contaminated with selenium (Se) in the late 1970s and early 1980s, was dried out and partially filled in 1988 with the intent of eliminating aquatic habitat that presented potential risks to wildlife. It was recognized, however, that during years of above-average rainfall, ephemeral pools that persisted from winter to early spring were likely to form. The years immediately following the filling operation, 1988-1992, had lower than average rainfall and consequently did not provide the observations and data needed to assess the risk to wildlife. Since 1993, several years with significantly higher than average rainfall have occurred (1993, 1995 and 1998), providing the opportunity to collect the data needed. In particular, the 1998 El Niño rainfall represents an extreme event that helps bound the range of likely conditions at Kesterson.

LBNL researchers have been working to provide chemical and physical input to the ecological risk assessment model, which is being jointly prepared with the consulting company of CH2MHill. The LBNL research objectives were:

- To calculate statistical distributions of water-soluble selenium in soils.
- To make long-term predictions of the extent and duration of ponding and ephemeral pool formation.
- To predict ephemeral pool selenium concentrations.

APPROACH AND ACCOMPLISHMENTS

Statistical distributions of soil selenium concentrations were calculated by habitat (open, grassland and filled areas), and by location within the reservoir. Statistical analyses of temporal trends along with modeling of selenium net oxidation rates strongly suggest that soluble selenium levels in surface soils will not change to an extent which would significantly affect long-term ecological risk.

The onset and duration of ponding were evaluated using a simple model that has been used successfully to estimate ponding at Kesterson for the period from 1990 to 1999. At Kesterson, ponding is largely determined by wet-season weather patterns. Since the meteorological database at Kesterson Reservoir is limited to only the past 16 years, weather data from nearby stations (Los Baños and Gustine), going back 126 years, was used to improve rainfall probability estimates. The model was also extended to provide estimates of areal ponding (Figure 1a).

Selenium concentrations in ephemeral pools were estimated based on the development of a transfer factor that relates the water-soluble selenium concentration in the top 15 cm of soil to the pool water concentration (Figure 1b). The transfer factor was derived from available field and laboratory measurements, augmented by additional soil sampling at ephemeral pool sites.

SIGNIFICANCE OF FINDINGS

The statistical distributions of soil Se, soluble Se, ponding duration and extent, and soil-to-pool water transfer factor are key input parameters to the ecological risk assessment model. The model has shown that long-term Se exposure is ecologically insignificant during most years, due primarily to the small extent and short duration of ponding. Exposure increases during exceptionally wet years, which may require preventative action. This approach has provided the first comprehensive long-term prediction of Se exposure risk to both aquatic and terrestrial animals.

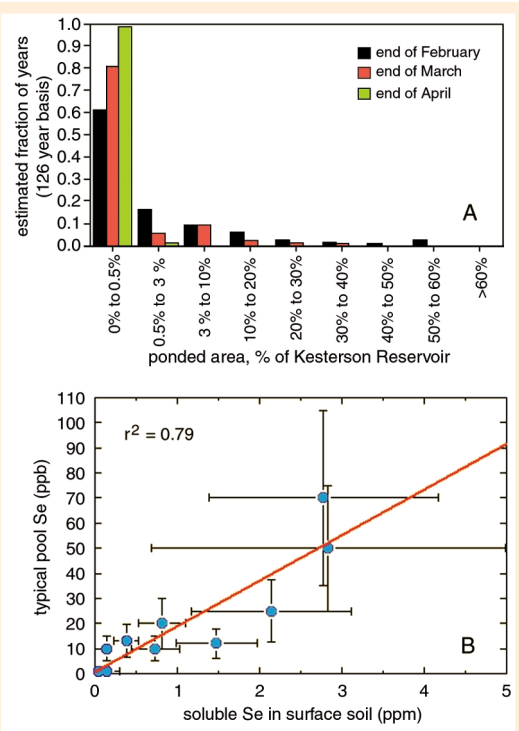

Figure 1. (a) Probability of a certain fraction of Kesterson Reservoir being ponded during the rainy season. (b) Calculation of soil-to-pool transfer factor based on typical pool values and soluble Se in surface soils.

RELATED PUBLICATIONS

Zawislanski, P.T., T.K. Tokunaga, S.M. Benson, H.S. Mountford, H. Wong, T. Alusi, R. Terberg and K. Olson, Hydrological and geochemical investigations of selenium behavior at Kesterson Reservoir, progress report to the U.S. Bureau of Reclamation, Berkeley Lab report LBNL-43535, 1999.

ACKNOWLEDGEMENTS

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